

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY



GEOLOGIC SEQUESTRATION CORE FLOW LAB (GSCFL)

Background

Successful geologic sequestration of CO₂ will require specific knowledge of the geo-mechanical/geophysical properties of the target strata. Characterization of key geologic features/parameters will enable more accurate computer simulations of efforts in geologic sequestration of CO₂, hence feasibility and costs will be more predictable. The specific information most needed includes: porosity, mineralogy, permeability, mineral/CO₂ interactions, Young's modulus, Poisson's ratio, and changes of any properties with prolonged exposure. If properties such as permeability are particularly dependent upon confining pressure on the minerals or CO₂ pore pressure, or very low permeability strata are being investigated, accurate characterization becomes extremely complicated because of involvement of more than one variable.

Oil and gas production require similar evaluations, particularly if coal bed methane (CBM) is being produced. The coal can swell or shrink, depending on the specific adsorbed/absorbed gas. Thus, permeability and porosity can vary depending upon amount of sorption/desorption. If formations are deep, causing very high lithostatic pressures, high confining pressures are needed to realistically simulate in situ conditions in the lab. Deep formations mean elevated formation temperatures; hence temperature control of lab test equipment is required. The same parameter evaluations are required for assessments of overburden/underburden strata sealing ability for preventing fugitive emissions from target sequestration strata.

The information provided by the GSCFL is essential, but is not a complete picture. Evaluation of a core, particularly coal which swells/shrinks upon sorption/desorption of a fluid and can change permeability and effective molecular weight during testing, requires additional evaluation. The GSCFL is able to evaluate only external core properties. The GSCFL research program will work in a complementary fashion with the NETL CT Scanner project which can see inside a core while it is being tested, as well as the ability to evaluate a core in real time.

Primary Project Goal

The goal is to be able to simulate the conditions found in all the major categories of potential geological sequestration sites including oil and gas fields, unmineable deep coal seams, brine formations, and natural gas hydrates. Ultimately, the data obtained from laboratory tests of rock types under a variety of controlled conditions



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and environments will provide information on the geotechnical effects and chemical interactions that occur when CO₂ is injected into natural rock strata with similar geological and geotechnical properties as those tested in the laboratory. These results will then be compared with those predicted by modeling experiments and will ultimately be used to improve the models. Closely linking the laboratory, field, and modeling activities in an iterative relationship will ensure accurate results and optimize progress. Independent reactors are used to test fluid/mineral interactions at high pressures and temperatures.

Objectives

- Obtain representative strata samples as per program/project constraints
- Prepare cores for testing to desired physical specifications
- Determine porosity
- Install inside AutoLab testing instrument, or high pressure reactors
- Set to specified test conditions-confining pressures, temperature, pore pressures
- Conduct tests, determining values of parameters
- Present results to modelers/NETL, publish technical papers



NERAutoLab 1500 unit

Accomplishments

The NER AutoLab 1500 unit has been installed, allowing permeability and geo-mechanical property measurements to be made. The unit is being mechanically modified to reduce times of measurements, which requires an assessment of programming steps of numerical solutions to obtain accurate permeability measurements.

Benefits

The type of information capable of being determined by the GSCFL is essential to realistic evaluations of the potential of CO₂ geologic sequestration, as well as oil and gas production. Much of this data is currently not available.